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MINING AND MILLING

IN THE

REESE RIVER REGION,

CENTRAL AND S. E. NEVADA.

BY

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The following pages were written for the purpose of giving a general idea of Mining and Milling operations in the Reese River Region, as conducted at the present time. Also, to point out such improvements as have been suggested by experience, and are easily practicable.

It does not enter into that minuteness of detail necessary for the precise information of the metallurgist, or mechanic, as that would necessitate the use of engravings, which the nature of this work precludes, but is intended for the use of the managers of companies and the general reader.

In the Eastern States but little reliable information can be obtained regarding Reese River, as the *Reese River Reveille*, is not taken even by Companies interested in that country, and what is published concerning it, is usually in the form of pamphlets, describing only one particular mine.

A. BLATCHLY.

NEW YORK, *January 31st*, 1867.

28678

MINING AND MILLING

IN

REESE RIVER.

THE location of the Reese River Mining Region, in the central and south-eastern portions of the State of Nevada, is too well known to need any particular description.

The mines in this region were discovered by employees of the Overland Pony Express Company, who named the first vein discovered the *Pony*, and the second the *Overland*, in honor of that Company. They formed the original Reese River Mining District, and made laws for its regulation.

As soon as this discovery became known in Nevada and California, large numbers of prospectors came and discovered many other mines, and formed a great number of new mining districts, until the Reese River Region embraces the whole south-eastern portion of the State of Nevada. It extends about three hundred miles north and south, by one hundred and fifty miles east and west.

The discoverers of the Pony and Overland Mines, finding that their ores assayed a considerable amount of silver to the ton, hauled several tons of the ore to Virginia for reduction; and as these ores came from near the surface, and contained the silver in the form of a chloride, they were reduced by the iron pan process with facility, giving a most satisfactory yield of silver.

In the course of a few months a number of companies were formed in Nevada and California, who erected mills for the reduction of the ores from their mines. As long as the ores were of the surface or chloride class, these mills, which were all built after the Washoe or Virginia pattern, gave very good results. But after the mines were opened to a sufficient depth

to produce sulphuret ores, the mills failed to extract the silver from them. Ores that contained over three hundred dollars per ton of silver, in combination with sulphur, antimony and arsenic, gave only ten or fifteen dollars per ton, when treated raw by the pan process. Gradually all of the mills encountered this kind of ore, and the result was an almost total suspension of milling operations in the district.

About this time the Oregon Company erected a reverberatory furnace, and roasted their ores with common salt, as in the Frieberg process, and were enabled to extract about eighty per cent. of the silver in the ore.

Other mills immediately erected the same character of furnaces, and obtained nearly or quite as good results.

Until this time no steam hoisting or pumping machinery had been introduced in the mines. All of the ore had been raised by hand-power, or, in one or two instances, horse-power had taken its place. The Savage Company now erected, for the use of their mine, the first steam hoisting works, and for nearly a year it was the only one in the district used for that purpose. To this engine, more than to any other cause, is due the success of that Company. The number of mills had increased to six or seven, and although laboring under many disadvantages, the production of bullion was very considerable.

In nearly every case the owners managed their own mills, and gave their constant personal supervision to all of the details of the business. No high salaries were paid, no unnecessary employees retained, and no exorbitant bills allowed. The taste for architectural display had not been introduced, and the mill buildings were constructed with a view to usefulness alone. Nearly all of the first mill men had been engaged in the same or similar business in California or Washoe, where the price of labor and cost of materials are about the same as in Reese River.

This experience enabled them to calculate the cost of an undertaking in this business with much greater accuracy than would have been possible without it. And although their mills were small, and they labored under the great disadvantage of very limited means, still the results were generally satisfactory. One of the greatest obstacles under which they operated was a lack of capital. Mining, like every other business that

is lastingly remunerative, requires a considerable outlay at the beginning.

In these mines, where water is found at about one hundred feet from the surface, steam pumping and hoisting machinery is absolutely necessary, and it is impossible to fully prove the value of a mine unless it is opened below the water level, and the construction of a twenty-stamp mill requires more capital than the prospectors in a new country generally possess.

Hence it was considered to be a matter of great importance for the proper development of the mining resources of the country, to secure the introduction of capital.

A number of different parties went to the Eastern States for this purpose, and by their representations succeeded in inducing Eastern capitalists to invest in mining enterprises in this portion of the State.

These Eastern parties, in nearly every case, avoided a very common mistake, into which the first operators in these mines almost invariably run, to wit: purchasing a few shares in a great number of mines, and owning a controlling interest in none.

They usually purchased the whole mine, and the trustees and superintendents were men from the East, and, except in a few instances, harmony existed in the management of the affairs of the different companies.

These companies have expended, in some cases, large amounts of money, and if their reasonable hopes have not been generally realized, it has been owing to bad management.

In the following pages, the more common and important errors into which they fell will be noted. One of the greatest of their mistakes was to build mills before the mines were sufficiently opened to supply them with ore. And in some cases a mill of sufficient capacity for the mine was pulled down, to give place to a new mill, without first increasing the production of the mine. A number of the best mills in the district were thus demolished, and a long time elapsed before the new mills were in running order, thereby causing a decrease in amount of bullion shipped from the country.

In building mills, sometimes little regard was paid to the season of the year in which the work was prosecuted; and in attempting to push the work in the Winter, when freights are double what they are in the Summer, an unnecessary expense

was incurred. The shortness of the days, and the coldness of the weather, also operated as heavy drawbacks to the economy of the enterprise.

In one case a mill was torn down which was located in a narrow gorge in a canon, and to lay the foundation for the new mill, a large expense had to be incurred in blasting away the cliffs, to make room for the new mill. The site is very inaccessible, and so scantily supplied with water as to have materially interfered with the workings of the former mill. For what purpose the old mill was destroyed, or why the new one was erected in that precise locality, is difficult to imagine.

All of the mills in this country are built on the same plan, and although sadly deficient in labor-saving machinery, still it is adhered to.

Many of these mills are beautiful as specimens of architecture, and would be considered ornamental structures in the most civilized communities. But the dust from the stamps, and the sulphurous fumes from the furnaces, soon give a dingy hue to the most elaborate ornamentation.

In some mills, the walls around the furnaces are built of stone or brick, and are of enormous thickness and very costly.

As working near the furnaces is always warm, even in the winter, partitions of boards, that can be removed at will, afford vastly better ventilation in the summer, and are all that is required in the winter. Owing to these and other causes, the cost of building mills in Reese River has been much greater than was necessary; in some instances as much as twenty-five or even fifty per cent. more than should have been expended.

As the proper location of a mill is usually fixed by natural causes, the error of placing the mill in a locality remote or inaccessible from the mine has generally been avoided.

ERRORS IN REGARD TO MINES.

In the management of mines, a number of errors have been committed. First, in regard to the value of the mines, and the means taken to ascertain their value and probable productiveness.

In some cases the statements of those interested, although strangers to the purchasers, were taken; and in others, agents

were sent to make an examination who never saw a mine in their lives before, and were totally unable to discriminate between quartz and limestone, or between oxide of iron and sulphuret of silver.

In the case of the owners of the mines, interest will almost always warp a man's judgment, even when he tries to be perfectly impartial, and ownership of a mine does not necessarily prove the owner to be skilled in its opening or working, or a good judge of the value of mines generally. Consequently, when the purchasers obtain their ideas of the value of the property from the owners exclusively, they usually overestimate the value of the mines purchased, and, also, had a false estimate of the time required to make them productive.

And the companies' agents sent to examine their mines sometimes returned with about the same ideas, and the same stock of knowledge that they had before making the journey. In many cases competent men were sent, who understood the subject and reported correctly.

Another mistake was to delay the opening of the mines until the mill was in running order; and, occasionally, when the mines were proved, they were found to be of no value, and the mills must be supplied from other sources.

SUPERINTENDENTS.

Many of those employed to superintend the affairs of mining companies were not well qualified for that occupation. Most of them never had any experience in that business before, and some of them were destitute of experience in any business whatever, while others were remarkable only for the number of failures that they had made in other branches of industry. This latter is a very poor recommendation; for the same general talents are required in all human affairs, and if a man is successful in one calling, he will be more likely to succeed in another than one who has failed in every enterprise that he has undertaken.

WEAK COMPANIES.

Some companies were organized too weak; when a few thousand dollars more were required than the original estimates they could not be raised, and all that had been expended was lost; when, perhaps, an additional sum, equal to one-tenth of that

already expended, would have given the enterprise a fair trial, and probably insured success.

Changing from one plan to another before any can be carried out, has been the bane of many mining enterprises.

These briefly appear to be some of the more prominent errors into which mining companies have fallen.

THE PROPER WAY.

I shall now proceed to give my views generally, in regard to what I consider to be the proper course to be pursued by a mining company; beginning with the organization of the company.

CONFIDENCE.

The managing committee of a company should be composed of men who have full confidence in each other's ability and integrity; especially should the trustees of a company have the fullest confidence in the superintendent.

ABILITY TO WORK.

The company should be organized with sufficient means, so that if the cost of the enterprise should overrun the estimates, the additional amount required can be promptly supplied. Or, if deemed expedient to prosecute the work with more vigor than at first anticipated, it can be done without inconvenience or delay.

CAPITAL STOCK.

The capital stock should be proportionate to the size and value of the property which the company proposes to work. When a company owns a number of large and promising mines, a large capital stock is required, but on a few small veins no large amounts of dividends can be paid on each share of a heavy capital stock. The stock should not be scattered too much, but should be held in sufficient amounts to cause a feeling of interest for the welfare of the company amongst the stockholders.

SINGLENES OF INTEREST NECESSARY IN A COMPANY.

And all of the stockholders should have the same end in

view, and be actuated by the same interest. Diverse interests in a company usually retard its operations, if they produce no other evil. As the management of the mines of a company wholly depends upon its organization, it is of the last consequence that it should be as perfect as possible. For more mining companies fail through bad management than through bad mines.

After a company is properly organized, the next step is to select a suitable mining property.

COMPANY AND PROPERTY MUST CORRESPOND.

On this much depends. If a company has a property larger than it can manage, which requires more means than it can raise, its works usually languish for want of funds, and there is danger of the enterprise being abandoned before a paying point is reached, and in such cases what is invested is usually a total loss.

The usual custom has been to adapt the company to the property, and it is probably the most judicious course.

Unless some member of the company understands the value of mines, the company must depend upon the judgment of some other party; and that party must be both honest, and competent, either qualification alone, will not answer. For unless a man has had a large experience he will most surely be deceived in his estimates of the value of mines, by the great diversity of appearances found in different veins in the same mining district. And in different districts, with a change of country rock, still greater diversity is observed. And equally as great difference is found in the appearance of the ores, as in the veins.

One man may be a good judge of mines after they are opened, and be almost totally unacquainted with the appearance of those that are undeveloped. Hence, the most useful knowledge in judging of their value in any district, is practical experience, and an opportunity of observing them at different stages of development. Analogy is the best guide in determining the probable value of an unopened mine. If two mines in the same locality, show the same indications at the surface, and one is opened and proves rich, it is a fair inference that, when opened, the other will prove rich also.

Many men, of great mining experience, have a bias for some particular kind of country rock, or peculiar style of mine to which they have been accustomed. If a man has been fortunate in a mine in slate, he fully believes that a mine in slate is much superior to one in any other country rock. But experience shows that nearly every kind of country rock, except perhaps the volcanic, contains valuable metalliferous veins. In Reese River rich silver-bearing veins have been found in granite, slate, porphyry, and limestone, although, in some districts, the limestone carries all of the valuable veins, and in others the slate, and in others the granite. Another believes that some particular dip or strike insures richness, while a different strike as surely points to barrenness. But rich veins are found striking to every point of the compass, and dipping in every possible direction.

Another, whose experience has been in small veins, condemns large veins as "not being true fissure veins, because they are too large," and one who has had his experience in the huge Comstock, verily believes that no money can be made by working small rich veins—each being equally in error.

A man may be a good chemist, or metallurgist, without ever seeing a mine in the whole course of his life. To determine the value of ores, recourse must be had to the skill of the assayer and metallurgist, but to determine the value of a mine requires the skill of a miner with a large experience.

In all cases, the party making the examination should be in the interest of the party proposing to purchase, and he should be held responsible for the truth of his report, and the more directly he is responsible, the less is the opportunity for circumlocution or evasions. In any event, the whole matter rests on the honesty and competence of the party who visits the ground and makes the examination.

PURCHASING MINES.

Mines which are desirable to purchase, may be divided into two classes:

FIRST.—Those on which but little labor has been expended, and the value of which can be accurately determined only by future explorations, though an approximate estimate may be made by an examination of the indications found at the surface.

SECOND.—Mines that are already developed, either artificially or naturally. Of course the prices paid for the two classes vary greatly; what would purchase one of the second class would buy many of the first.

A few of the most important points in estimating the value of a mine will be briefly noted:

INDICATIONS.

First in importance, is the thickness of the vein, and unless a vein is six inches, or over, in thickness, its value is very doubtful, unless it is remarkably rich.

The average weight of the ore in these mines is about a ton to fourteen cubic feet, as the ore is found in the vein; consequently, a portion of a six-inch vein, twenty-eight feet long and one foot wide, is required to make a ton. But the thickness of all veins varies, and many that are two feet in thickness in some portions, do not give an average of six inches for the whole length of the claim. At this thickness, a claim one thousand feet long and two thousand feet deep, would produce seventy thousand tons of ore. This calculation is made on the supposition that the vein continues of the same size in every portion of the claim; but such is rarely or never the case, and one-half or thirty-five thousand tons is all that can be expected from a vein of that thickness. A vein of two feet thick will produce four times as much, or one hundred and forty thousand tons, allowing one-half of the claim to be unproductive. The cost of working a vein six inches or two feet in thickness, is the same. The shafts must be of the same size in each, and the amount of water and timbering in either is precisely alike. The cost of stopping is as great in the small vein as in the large one, and a two feet vein of the same richness is more than four times as valuable as one of six inches; and when of the same richness, a two feet vein can be worked at a marked profit, when working the small one would be productive of loss. In many cases a vein may be only six inches thick at the surface, but at the depth of one or two hundred feet, it may be two feet in thickness, or over; but if a vein is followed down for the distance of three hundred feet, and its thickness does not materially increase or diminish, it will probably hold the same size for two thousand feet or more. Two thousand

feet is as deep as veins are usually followed in mining countries, and many mines do not pay to follow so far. For all practical purposes it may be considered the bottom of the mine.

Another very important point is the distance that a vein can be traced on the surface. If it can be followed on the surface for the distance of a mile, it is an almost infallible sign of a deep and lasting mine. But many veins of great strength and permanence, do not crop to the surface for but a short distance.

The condition of the walls of a vein is of great importance in forming an opinion of its depth and permanence.

In the countless convulsions of nature, different portions of the surface of the earth have been alternately elevated and depressed, and when deep fissures, like a true fissure vein, extend far down into the earth, the movement and friction on it must be very great, giving it an exceedingly high polish. This polish, which is found on the hardest quartz, is caused by the enormous pressure and friction on the vein, which is called by miners "slickensides," and is considered to be one of the very best indications of a deep and lasting mine. But if a vein does not extend far into the earth, no polish will be found on its sides; and when both sides firmly adhere to the country rock, there is but very little probability of its being deep or continuous.

DIP AND STRIKE.

The dip and strike, should be also observed; if they conform to the dip and strike of other veins in that vicinity, which are rich, it is a favorable feature in the case.

POSITION OF THE MINE.

If a mine is near another that is rich, it is a very favorable indication, especially if it be in range of the rich vein, or so situated that it may be an extension or continuation of it.

RICHNESS OF THE ORE.

This is one of the most difficult points to determine. All good mines vary greatly in the richness of the ore that is found between their walls at different points. In many mines the quartz is arranged in different strata or layers, one of which will be rich, the second one poor, and, perhaps, the

third one moderately rich, the fourth totally barren, and the fifth very rich. In actual practical working one portion of the vein is worked and another portion rejected. Hence, it is easily seen that a vein may be large and contain a small, very rich, stratum, which gives very high assays, and still the whole vein will not pay to work. While another vein, where the ore is very generally diffused, may fail to give any very high assays, but pay largely for working.

A plan adopted by many mining engineers of estimating the value of the ore between the walls of a vein, is to cut across the whole vein from one wall to the other, at a number of different points, and take an average sample from the cutting obtained at these several points. By this method, if well conducted, a very close approximation may be obtained of the value of the whole mass of the veinstuff between the walls. But while this gives a true idea of the value of the *whole mass* between the walls, it does not give a correct idea of the value of the *ore* in the mine.

As, for instance, the Murphy, at Twin River. This vein is about twenty feet thick, and is composed of two different strata, one of which is large, rich and very valuable, constituting one of the best mines in the country. The other is almost barren, but contains a small amount of silver, being larger than the other; if the whole mass of the veinstone between the walls were assayed, it would give too low an average to work at a very high profit at the present time; although in process of time, when the cost of mining and reducing ores will be greatly less, it is probable that the poorest stratum will pay a profit for working.

The correct way is to assay the workable ore, selecting the samples from that portion of the vein which an experienced miner would take for milling purposes; and then ascertain if it can be obtained in sufficiently large amounts to make its extraction profitable.

VARIETIES OF ORE.

Another very important consideration is the kind of ore that is found in the mines, and whether that same variety of ore has been successfully reduced by the process of reduction usually employed in the country. Silver combines with many different

substances, forming a great variety of ores, possessing very diverse characteristics, so that entirely different metallurgical operations are required for their several reductions. Silver ores that contain large amounts of antimony and arsenic or lead, cannot be worked as cheaply or closely as those that contain only iron and copper, by any working process now in operation in Nevada. Ores composed principally of lead or argentiferous galena, have not been profitably worked in the State.

The abundance or scarcity of wood, water, salt, and forage, and the accessibility of the mines, have a great effect on their value. All of these circumstances should be duly considered in forming an estimate of the cost of opening and working a mine.

The same general rules apply equally well to mines that are opened. The only difference being that those have an assured value according to the amount of ore already open, as well as a prospective value to be determined by further developments.

PAYING ORE.

In districts like Twin River, Hot Creek, Reville, Philadelphia, and in others where vast bodies of ore are found in the sides of the mountains which can be extracted at a small cost and in unlimited quantities, ore that will pay twenty-five dollars per ton, without roasting, will yield a handsome profit for judicious, and economical working. And ores that require roasting, which yield from thirty to thirty-five dollars per ton, will also give a good profit, provided they can be obtained at a small cost, and in unlimited quantities.

But a vein that is only two feet thick, where machinery is required for hoisting and pumping, ought to pay forty or forty-five dollars, to yield any profit for working.

In small veins of six inches in thickness, where the mine has to be unwatered, a yield of about one hundred dollars is as low as will pay to work. But under particular circumstances, a small vein may be profitably worked at a very much lower yield. As where it crops to the surface on the side of a hill, or when found in a mine that is worked for some other vein. In the Cornish Mines, a vein of gray copper ore only one inch in thickness will pay for working.

The above rates are calculated for the present time, with the mills and processes now actually in operation.

Any improved process of reduction, whereby either more silver can be saved at the same cost than at present, or if the same amount can be extracted at less expense, or should both of these desirable objects be accomplished, then the working of lower grade ores can be made profitable. And there can be no reasonable doubt that such process will be found by the untiring spirit of improvement which is now actively investigating this very important subject. And in case no improvements should be made, the construction of the Pacific Railroad will inevitably greatly reduce the cost of working ores in the Reese River Region.

When proper care has been exercised in selecting mines, taking only such as show decided indications of value, but few mistakes will be made; and in this country, where there are so many desirable mines, there can be no excuse for attempting to open a mine that does not show good indications of value at the surface.

OPENING MINES.

In opening a vein that is totally unworked, reference must be had to the natural advantages, or disadvantages; but to continue the work of a mine that is already opened, attention must be paid to what is already done. A mine may be opened on a bad plan, and the work on it progressed so far that it is better to continue it, than to make a change in the originally defective plan. Hence general rules do not apply as well in practice to mines that are opened as to the opening of unworked mines.

This is one evidence of the great necessity of adopting a correct plan for opening a mine at the beginning.

There are three principal modes of opening mines in this country, to wit: by a tunnel, by a shaft, and by an inclined shaft called an incline. Each is adapted to particular localities.

TUNNELS.

Where a vein crops out on the side of a mountain, and a tunnel can be run into the mountain on the vein, it is much superior to any other method. No pumps for unwatering the mine, no machinery for hoisting the ore, are required, and the work can be prosecuted in the vein, showing its character at every foot, and constantly producing ore. When a mine is naturally

opened in this manner, by depressions at the foot of a mountain, as by a vast natural shaft, the cost of extracting the ore is greatly less than where machinery is required.

This is the most favorable situation for a tunnel, but it can be employed to marked advantage in many other cases, especially when it can be driven into a mountain and cut a number of veins in close proximity to each other. Its use is limited to mountainous or hilly countries, and then only in certain localities.

VERTICAL SHAFTS.

This method of opening a mine is generally preferred by nearly all experienced miners, in all cases where a large amount of water has to be elevated from a considerable depth, or where large quantities of ore are raised daily. In such cases it presents the most efficient and expeditious method of working. Although in some of the Lake Superior copper mines an incline was preferred after a trial of a vertical shaft.

There is one advantage that a shaft possesses in a country like Reese River, which is this: that as its course is arbitrary and cannot be changed at the caprice of the manager, it forces the exploration of many veins that would not otherwise be opened. Or it operates like a system of cross-cuts from an incline, and when the manager sees the advantage of this system of cross-cutting that has been forced on him, he usually continues it. Some of the best mines in Lander Hill were developed in this manner.

The mines in this Hill are peculiarly adapted to this method of opening, being usually at a dip of about forty-five degrees, and considerably dislocated by faults, as well as in close proximity to each other. And a shaft opens a number of veins and allows the ore to be taken from them at less cost than by any other means.

Hence this is the favorite method of miners in Lander Hill, who consider that the richness of the Hill in its depths, has been sufficiently proved to justify the sinking of a vertical shaft without any extensive previous exploration by means of an incline.

Another advantage a vertical shaft has over an incline is, that it does not require as strong timbering to prevent its

sides from collapsing. This is an important consideration in a country where timber is scarce and dear.

All shafts, where a large number of workmen are employed, should be supplied with safety cages for the miners when entering or leaving the mine. Some of the latest and most improved cages seem almost to preclude the possibility of accidents where ordinary care is employed to guard against them.

In sinking a shaft its size should be in due proportion to the object for which it is intended. If it is to be of great depth, and calculated for raising large bodies of ore and great quantities of water, it should be of large size. The general mistake has been to make them too small.

A number of fine shafts have been sunk on the Comstock lode at Gold Hill and Virginia, some twelve feet square, and some twelve by sixteen feet, and for the work that is required of them these sizes are absolutely necessary.

INCLINES.

For prospecting and partially opening a vein, an incline is superior to either a shaft or tunnel, except under particular circumstances.

An incline is a shaft following the vein, and its inclination corresponds to the dip of the vein; hence, some inclines are nearly vertical and others almost horizontal. An incline proves the vein at every step, showing its size, richness, continuity, and general characteristics. In a very rich vein the ore taken out in sinking the incline will defray the expenses; and in others of less richness it will pay a portion of the cost of sinking.

In all true fissure veins the rock near them has been softened by friction and the action of their chemical constituents, and it works much more easily than where the country rock is beyond the effect of these agencies. This renders the cost of sinking an incline much less per foot than in a vertical shaft, which is usually sunk in the country rock away from the veins, except at a few points.

After an incline has been sunk to a considerable depth, cross-cuts can be run at right angles to the usual strike of the veins in that vicinity, with as much facility as though the same depth had been attained by a vertical shaft.

Proving and working other veins in its immediate vicinity, is one of the most important uses of an incline. Several veins can be worked from the same incline at a cost of fully forty per cent. less, where they are near together, than if each had to be worked alone by a separate incline or shaft. In this manner many veins can be made to yield a profit that otherwise would not pay for working.

In sinking an incline, the main object is to follow the vein, and any one not well acquainted with the business, would suppose that this would be a very easy matter; but more mistakes have been made in Reese River, by following a spur, and supposing it to be the main vein, than in almost any other mining operation. By a simple and inexpensive system of cross-cuts, this error can be entirely avoided. After an incline has been sunk in the vein, to the depth of three hundred feet, and two or three sets of levels driven from each side, the value of the mine can be very correctly determined. When opened in this manner the amount of ore that can be taken from the mine can be calculated with a great degree of accuracy; and also the amount that can be taken out in a given time, which is frequently very desirable to know.

And by working a few tons from different portions of the vein, a very close approximation can be had of the value of the ore, above the lower level in the mine.

It is then known whether there is sufficient paying ore in sight to supply a mill, or whether it may be advisable to sell the ore as it is taken from the mine; or to employ custom mills to reduce it.

Some of the most successful mining enterprises in this country are conducted in this manner.

But if a vein is opened to the depth of three hundred feet, and drifts driven at the most favorable points, without finding good ore, or favorable indications; and if a system of cross-cuts shows nothing valuable, it will not be necessary to continue the explorations any farther.

Up to the present time, no vein with good indications of value at the surface, has been opened to that depth without developing a valuable mine in the Reese River region.

In opening a mine by a shaft or incline, the first hundred feet can generally be sunk as expeditiously and more cheaply

by a hand windlass than by the employment of a steam engine; but beyond that point and after water is met with in quantity, steam power is an indispensable necessity.

MACHINERY.

The machinery should be adequate to *all* of the wants of the mine, and in all cases a reserve of power should be available when required. All should be of the very best material and workmanship, for the cost of freight is just as much on the poorest machinery as on the best of the same weight. And freight is one of the heaviest items of expense in this country in obtaining machinery for a mine or mill.

As scarcely two mines are alike, or require exactly the same machinery, it is always advisable, after deciding to erect it, to get a competent machinist to make a plan and drawings of what is required. In this manner the cost of freight saved will more than pay the expense of the plan and drawings without regarding the superior efficiency of the machinery that is designed and adapted to the particular requirements of the mine.

In many mines in this country the rock is sufficiently firm to stand without timbering, while the preliminary explorations are being made. But if permanent work is intended the incline and drifts must be rendered secure by timbering. These are the highways to the ore in the mine, and unless they are in good condition the ore cannot be transported from the mine to the surface. To keep them open, and clear of water they should be securely timbered, and this should be done at the beginning, so as to prevent any accidents afterwards.

In all cases where human life is concerned a wide margin should be left for safety, and this should be particularly regarded in mining, where men are exposed to so many accidents that are unavoidable.

After a mine is opened, and enough ore is in sight to supply a mill, the work of exploration should be vigorously continued, so as always to have equal reserves of ore immediately available until the mine is exhausted. Want of attention to this necessary measure has been the cause of serious embarrassment to many mining companies in this country; and particu-

larly to many companies at work on the Comstock lode in Virginia.

In some of these companies' mines, after they were opened and a large body of ore rendered available, no further work was done to open out other bodies of ore. Consequently, after their reserves of ore were exhausted, no more could be obtained until fresh explorations were made, and their mills had to remain idle. No dividends could be declared, and the stock of the companies went down, causing great distrust of the value of the mines.

This evil is now remedied, and the mines on the Comstock are producing more bullion than ever before, and exploration is kept well in advance of working.

SELECTION OF SUPERINTENDENT.

After a company have decided to open a mine, the next step is to select a suitable person for the superintendent. This is a very important matter, as the success of a mining enterprise depends upon it in so great a degree.

In incorporated companies favoritism should be carefully guarded against. If a man owns a large amount of stock in a company, he sometimes has a needy friend or relative, whom he wishes to assist by putting him in some position in the company where he can earn his bread, without regard to his fitness for the situation. Such men usually have no force of character, and are totally unqualified to take charge of an enterprise like mining in a new country.

These men fail through their own weakness, and as they generally do as well as they can, they fully believe that the failure was owing to the bad character of the property which they attempted to manage; and they decry the whole country and all its enterprises, on account of their own feebleness.

Mining and milling combined, form such a diversified and complicated business, that it is very difficult to find a man that is fully competent to manage each separate branch of it.

The skill of the miner, metallurgist, accountant and merchant, is required; but if the superintendent is a man of good sound common sense, and possesses efficient executive ability, combined with experience in business transactions, he will encounter no serious difficulty.

Mining is like all other branches of human industry, and requires the same ability to manage it.

Some people labor under the impression that unless a mining company is composed of miners, that its affairs will be badly managed; but there is no more reason for such an idea, than there is to suppose that the legal affairs of a company will be neglected unless all of the company are lawyers.

A superintendent should have, if possible, experience in the same business in the same country, where he is required to operate.

In Virginia and Gold Hill, where mining for silver is carried on more extensively than at any other point in the world, a man cannot get a situation to superintend a mine unless he has had a considerable experience in mining in that country. And success in the management of one company will give a situation in another, if desired.

In a new country like Reese River, the fluctuations in the prices of staple articles are often great, in a short time, offering great temptations to agents and superintendents, to make money at the expense of the company; hence, it is of great importance to get a man on whose honesty the utmost reliance can be placed.

A system of counter checks, should be placed on every officer that has the handling of the funds of a company. Each officer should report directly his transactions to the Board of Trustees, so that there can be no forcing a balance in the accounts.

By the exercise of the same care that is used in other kinds of business, the officers of a mining company can be held to equally as strict an accountability.

After a superintendent is appointed he should visit the ground and mature his plan of operations.

This he should explain fully, both by writing and drawings, and descend freely into all of the most minute particulars, and, as far as possible, give his reasons for each recommendation.

The plan should meet the superintendent's entire approbation, so that he will feel personally responsible for its success.

He should state the length of time that he considered necessary, and he should be given all that he requires. As a mine is a most durable property, it is not reasonable to suppose that it can be made remunerative without a sufficient length of time

to develop it; and opening a mine is a business that cannot be expedited beyond a certain rate; any attempts to the contrary are productive only of loss.

The estimates of the cost should be as full as possible, and itemized to the fullest extent, and all probable contingencies provided for.

Under this head, particular regard should be paid to the season of the year, and, if necessary, the work should be delayed until the proper time arrives.

An unopened mine does not injure by time, and the ore will be equally as rich many years hence as at the present moment, and probably much more valuable.

The manner of opening the vein should be fully elucidated, whether by tunnel, shaft, or incline, distinctly setting forth the purpose for which the work is to be done, and the results expected to be accomplished; also, what machinery he requires, and for what purpose.

Be sure that you are right when you go ahead, applies to mining as pertinently as to any other occupation.

Mining is like book-keeping. If the mine or book be properly opened at the beginning, the continuation of the system is comparatively easy. Hence, the best available skill should be secured to devise a plan of operations at the outset.

Analogy is of the greatest assistance in such cases. If a similar work has been executed in the same district, the time and cost can be calculated with greater accuracy than were possible otherwise, and any defects observed in the work already completed can be avoided in the new one.

The plan should be such as to inspire confidence and give satisfaction to all parties concerned, so that each one will work with a will, and a determination to make the enterprise successful.

After the plan is matured, it should be accepted by the board of trustees, and the superintendent should be supplied with abundant means and allowed sufficient time to carry his plans out fully; and in none, except extreme cases, with the approbation of the superintendent, should the plan be materially changed or altered.

Minor changes, the very progress of the work will suggest, and the superintendent being on the ground can make them to

suit himself. Such changes are generally required to be made immediately, to meet the requirements of the work as it progresses.

When all of the beforementioned precautions have been taken, success is almost always certain, and in the few cases that will fail, the stockholders know that the most economical and judicious method was employed, and that the actual loss was kept within the lowest possible limits, which, with the best management, will always be merely nominal.

In opening a mine, at the beginning it is always advisable to hire the workmen by the day or month, until the character of the work is pretty well known, but after that it is cheaper for the mine owner to have the work done by contract. In contract work the miners require no overseeing, and if a miner does an extra day's work he gets the benefit of it. In the same time men will always do more work under contract than when working by the day or month, and the company pay only for *work* actually done, not for *time* "put in." The result is that the company get their work done cheaper, and the workmen make better wages.

In some mines the contract is so much per ton for a certain number of tons; in others, it is so much for opening so many feet or fathoms. The particular method can be best determined by the nature of the work to be done.

When a mine is properly opened from the beginning, its further working can be continued as long as is desirable, but if the original plan is bad, the cost of working the mine afterwards will be much greater than is necessary.

BUILDING A MILL.

After the mine is opened in such a manner as to prove that it contains the requisite amount of ore to supply a large mill for one year, and after its value has been proved, by working a large number of tons from different parts of the mine, then it is desirable to erect a mill.

As all of the work necessary to construct a mill is above ground, it can be calculated with far greater accuracy than the cost of mining operations, which are conducted below the surface of the earth. In a mine, the rock may be harder or

softer than was anticipated, also, the water may be more or less abundant than was supposed; but by consulting the founder and machinist, the original cost of the machinery for a mill can be accurately determined, and the freighter and mill builder have a uniform scale of prices, according to the season of the year. By putting the whole work under contract to responsible parties, not only can the cost be known, but also the time required to erect the mill.

By adopting this method, the vexation and embarrassment of having the actual cost greatly overrun the estimates, can be entirely avoided, and there are fewer chances for the superintendent to bring in bills of "incidentals." Of course, always requiring the work to be in *advance* of its payment.

A mill should be located with special reference to the mines that are to supply it with ore. If it can be done without too great sacrifice of other considerations, it should be placed so that the ore will not require to be hauled at all, or if this be necessary, but for the shortest distance.

One error into which companies are liable to fall, is to experiment with new and untried "processes," "roasters," "crushers," "amalgamators," &c., &c. This is usually the fault of beginners, who always see all of the advantages of any new contrivance, but do not perceive its defects.

The reduction of ores containing the precious metals is one of the most ancient of human occupations, and if the history of all the various processes that have been tried and found wanting were well known, it would obviate the necessity of trying many "new inventions."

A mining enterprise in a new country is sufficiently experimental in its character itself, without testing the crude and untried notions of inexperienced men, who have no knowledge of the scientific, or mechanical, principles on which the most approved methods of reduction practiced at the present time are founded.

Experiments on a large scale in metallurgy (the only way in which the value of any process can be determined) are very costly, and, in all cases should be entrusted to an experienced, scientific, and practical man—one who thoroughly understands all of the various methods of reduction of the present day, and is also well versed in metallurgical history.

After a mill has been run for some time, many changes will suggest themselves to the one who has charge of it, and these changes will be gradual, and the result of careful examination, and all of them will be improvements. Changes introduced in this manner are almost always beneficial, while any great changes are usually injurious.

In the construction of mills, and in the methods of reduction, there is a greater diversity than in the modes of opening mines.

All the valuable processes in use at present in Nevada rest on nearly the same chemical principles, the difference being in the mechanical arrangement.

The greatest error in the construction of mills in this country is the absence of labor-saving machinery. It is poor economy to employ hand power when steam will answer just as well or better.

Less than a twenty-stamp mill should never be erected where good custom mills are accessible. If a mine will not supply a mill of that size it is better to sell the ore, or have it worked in a custom mill. Of course this does not apply to new districts where there are no mills. In such cases the management must conform to the circumstances.

A five-stamp mill requires as many engineers, and battery feeders, and as skilful a superintendent, as one of twenty stamps; and the whole number of men required in the small mill will be only about one-third less than in the larger one, while its capacity is fourfold less. Dry crushing is usually practised in this country, and the average duty is about one-half ton to the stamp head. In Virginia the average duty is about one ton and a half, crushing wet; and dry crushing is injurious to the machinery, and prejudicial to the health of the workman.

ROASTING.

The roasting of the ore is one of the most important parts of the whole process of reduction; unless this is done well it is impossible to extract the silver by amalgamation with any considerable degree of closeness. The way that it is conducted here renders it one of the most expensive parts of the reduction. The furnaces are worked by hand, and it is very difficult to get workmen who understand the business. By the use of a mechanical furnace this difficulty can be avoided.

Machinery does what it is made to do, and does not get weary, or forgetful, and neglect its business.

In a properly constructed mill after the ore is put under the stamp it should never be moved by hand again. It should be crushed wet, and elevated by machinery to the drying furnaces where it should be stirred by machinery until it is dry, to prevent the formation of lumps that might interfere with the roasting. After crushing, the slimes or fine sediment should be allowed to settle in vats or tubs. It has been found that after the water from the battery has passed through ten or twelve vats it becomes clear. After these slimes have settled they can be collected and dried, and worked the same as the other portions of the ore.

Fine crushing is not necessary for roasting; it is even prejudicial, as coarsely crushed ore roasts more quickly and with less loss, either by volatilization or by being carried up the chimney by the draft, than when crushed very fine; and coarsely crushed ore is much less liable to form lumps, either in drying or roasting. Coarse crushing is much more rapid, and less expensive than fine, and forms less slime that is difficult to settle and collect.

Amalgamation requires the finest possible grinding, and this is more surely and cheaply done after the ore is roasted, and softened, than before, only one-fifth or one-sixth the power being required to grind it after being roasted, that is required previously.

When dried, the ore should be carried by machinery to vats, above the furnaces, which should be so arranged that by drawing a grate the furnaces can be charged.

FURNACES.

A twenty-four stamp mill crushing wet will require fifteen furnaces of the largest size. In this country, one man attends to two of them at the same time, working six hours per day, so that it requires the labor of two men to run one furnace twenty-four hours.

Properly arranged mechanical furnaces would effect a great saving in expense, and materially lessen the cost of reducing the sulphuret ores of this country.

In districts where roasting is not necessary, as in Philadel-

phia and Hot Creek, the cost of reduction is greatly less than of the refractory ores that are found in the greater number of mines in Nevada.

It is often a very nice question to decide, whether it is advisable to roast the ore, or not. In a majority of cases more silver can be saved by roasting, but the cost of reduction is also increased: as in the mines at Virginia, where, by the use of iron pans, sixty per cent only is saved, but still the working gives a fine profit; whereas, by roasting and extracting ninety per cent of the silver, a loss is made to the operators.

Nearly every metallurgist on a first examination of the pan process, as practised at Virginia, condemns it, but so far they have totally failed to replace it by a better process. After the ore is roasted it should be conveyed by machinery to the iron pans, ground finely and amalgamated.

A mill of this size, with the necessary labor-saving machinery, requires eight men to run it: one for the engine, one to feed the battery, three to attend to the furnaces, two for amalgamators, and one to oversee and to make himself generally useful. To run constantly, two sets, or fifteen men, are required. In the manner in which mills are usually arranged, one of this size requires forty-five men to run night and day, to wit; thirty men for the furnaces, four to feed the battery, eight to amalgamate, and two to move the ore around the mill, and one to oversee.

A mill of this size will reduce thirty tons per day of the ores ordinarily found in Reese River. But if the ores are softer, or contain less refractory substances, the amount can be considerably increased.

LOSS IN WORKING.

In Reese River, in the best mills, the usual loss is about ten per cent. of the assayed value. Of this amount, probably eight and a-half per cent, is lost in the roasting, and the other one and a-half per cent, in the amalgamating. It is probable that when the present mode of reduction is improved, that the loss will be three or four per cent, less than it is at present.

The mill building should be plain and substantial, and the portion that encloses the furnace must be arranged so as to secure the fullest ventilation, which is a point often neglected.

In building a mill, the same or even greater advantages are

gained by having the plan well matured, and illustrated both by writing and drawings, than in the opening of a mine. A comparison of the merits of mills already in operation, is a great assistance in forming a plan for a new one.

When a company have their mine opened, and a mill completed, the work should be vigorously pressed by the employment of as many men as can work to advantage in the mine, and keeping the mill constantly running; for every day that the work of extracting the ore is delayed, necessitates an useless expense of keeping the mine clear of water that much longer; and if pressing the work in a mine causes it to be worked out fifty years sooner than it would otherwise have been, the cost of keeping the water out for that length of time can be added to the profits of the enterprise. And the interest on the money invested in a mill runs on whether the mill is running or not, and every day brings us nearer the time when some new process will be introduced which may cause a radical change in the construction of the mills.

VALUE OF ORE.

If the cost of working ores by any process, including mining, is twenty-five dollars, ores that pay twenty-four dollars per ton by that process are of no more value than those that contain only ten dollars, or nothing; while ores that contain twenty-seven dollars, are worth twice as much as those which contain twenty-six dollars. And a ton of ore that contains one thousand dollars, is much more valuable than twenty tons that contain fifty dollars each.

CRUSHING MACHINES.

Stamps and iron pans, are the only machines in general use for crushing and grinding ore in this country.

Many new machines for crushing and grinding have been introduced, and many of them worked well for a short time, but soon gave out, not being sufficiently strong and durable. The veinstone in this country is almost invariably quartz, which is one of the hardest of known substances, and a machine for its crushing must be durable as well as efficient.

MODES OF CRUSHING.

Three different methods of crushing or pulverizing quartz, or veinstone, are in use, and each seems to have special advantages for particular cases.

First—By pressure, as in rollers and Blake's Mill. These machines are adapted to coarse crushing only, but for that purpose they are less costly both in construction and operation, as well as more rapid in their action, than any other machines yet invented. For the general purposes of mining and metallurgy, rollers, on account of their greater simplicity and strength, are probably preferable. They have been in use for a long time, and appear to have the improvements that are suggested by experience.

Second—By percussion. Aside from hand hammers, stamps appear to be the only machines of this kind worthy of notice.

This machine has been greatly improved in the last few years in Virginia, Gold Hill, and Grass Valley. And the revolving stamp, with double or single cams, according to the requirements of the case, is superior to any other. It is adapted to moderately coarse, or very fine crushing, and works equally well wet, or dry; is strong and not liable to get out of order, and the parts that wear are easily and cheaply replaced. With these advantages it is the favorite machine in California and Nevada, where, in all well built mills, in conjunction with iron pans, it forms the sole crushing machinery.

Thirdly—Iron pans, arrastas, horizontal, and edge mills, and all other machines that operate by friction, or grinding. These are suitable only to very fine grinding, and in all of them the ore must be previously crushed to a moderate degree of fineness, before these machines can further reduce them. Millstones, also come under this head, and in certain cases, are a very efficient machine.

All of these machines are adapted to particular cases, but for general use, the iron pan is superior to any of the others. It is a grinder, and an amalgamator, of the most efficient character, and its action brings forth high chemical effects, which are but imperfectly understood, even by those who have given this subject the most careful consideration.

To the scientific chemist and metallurgist, there are few

subjects of as great scientific, or financial interest, as the chemical changes wrought by the action of the iron pan, especially when taken in connection with the action of the reverberatory furnace.

The above comprises nearly all of the machines for crushing and grinding that are in common use, and it appears that where there are so many machines that have been tried for years, that there can be no difficulty in making a selection suitable to the requirements of any particular case.

CONCENTRATION OF ORES.

In all of the greatest mining countries in the world, the concentration of the poorer ores, before subjecting them to a metallurgical operation, is considered an indispensable necessity. Without it, all of the oldest and most extensive mining districts would have to be abandoned.

In this country but little attention has been paid to this subject; hand sorting before working, is in general use, and some attempts to concentrate the tailings from the mills, have been made by machinery. But after the ore passes through the iron pans, it is ground to a fine slime, which renders its concentration very difficult. Twenty per cent. of the ore remaining in the tailings, is as much as has been saved on an average. As the tailings are ready for concentration, as soon as they leave the mill, and as it requires but little manual, or mechanical power, the saving of twenty per cent, or even less, when properly managed, will be productive of profit.

The better way, is to concentrate the ores first, and reduce them afterwards. All of the ores require crushing for this operation, some must be crushed fine, and others coarse, and the requirements of each particular case can be determined only by experiments in the large way.

Rollers will probably crush as fine, as is necessary in a majority of cases, but this, and many other points, can be known only by a careful study of all of the conditions and peculiarities of the mine, where the operations are to be conducted.

The cost of concentrating the ores need not be but little more than that of preparing them for roasting, while the saving effected in the quantities of wood and salt consumed, and the less amount of labor requisite to work the greatly

reduced bulk of ore, will give a fair profit for working ores that will not pay by the present method of reduction without concentration.

In various portions of this country, as Twin River district, and in many others are numerous veins of enormous size, which do not contain silver in paying quantities for reduction without concentrating. But by it these veins, though now valueless, can be made to yield very satisfactory results by working.

In ordinary second class ore, or that which requires this process, the valuable material in six tons can be obtained in one, or the concentration may be even more than that.

The round buddle, and the shaking, and percussion tables, either in their original forms or with modifications to meet the requirements of particular cases, will probably be the most efficient and economical machines for the ores in this country.

The great want of all of the mines in California and Nevada is some means whereby the lower grade ores can be made available, and concentration appears to be the most reliable remedy. When this is fully understood and practised, the increase in the yield of the precious metals will be more than one hundred per cent of the present production.

PHILLIP'S METHOD.

This method was introduced in certain mines in Spain by the eminent metallurgist, J. A. Phillips. The ores that he beneficiated were composed of the same constituent substances as the great majority of the ores in Reese River, the associated metals being antimony, arsenic, copper, iron, &c.

It involves the use of no new chemical principle, but is substantially the Frierberg process, the only difference being in an improved mechanical arrangement. It has been proved in the large way for years, and is better adapted to the wants of this country than any other yet devised.

The ores are first crushed by rollers, which is the cheapest mode of crushing yet known, and reduces the ore sufficiently fine for this purpose.

The advantages of this mode of crushing are that the cost of rollers is greatly less than that of stamps, and that they will crush a much greater quantity in the same time, and at less expense.

But the greatest advantage is that the ore is crushed coarser, and the loss in roasting is three or four per cent less than when crushed fine, and less time, and fuel, are required to roast the ore than when it is crushed finer. When crushed coarse, the fire permeates through the whole mass, but when it is too fine the flame cannot pass through the ore, but passes over it, and affects only the outside of the mass of the ore on the hearth of the furnace.

The loss by volatilization is less, and also the mechanical loss, or that portion which is drawn up the chimney of the furnace.

The furnaces are self-feeding, self-stirring and self-discharging, and one furnace will roast four tons in twenty-four hours.

One workman can attend to four furnaces at the same time.

The general form of this furnace is the same as the Frieberg furnace, and the chemical changes effected are precisely the same, but as the work is done by machinery, it is much more evenly and uniformly done than can be done by hand. The disadvantage of always having that portion of the furnace nearest the firebridge hotter than the other portions is avoided.

The cost of construction of a furnace of this kind is greater than of the ordinary ones, but the cost of constructing a given amount of furnace capacity, is less than in the Frieberg furnaces.

After roasting, the ore is ground in mill stones, to reduce it to the proper condition for amalgamation. In roasting, the ore is greatly softened and decomposed, so that not more than one-sixth the power is required to grind it after roasting, that is before it is softened in the furnaces.

This after-grinding is of great importance, as it reduces the ore to an impalpable powder, and leaves it in the best possible condition for amalgamating. And if the ore contain gold, as many of the ores in Nevada do, in roasting it becomes coated with oxide of iron, and other salts formed in the furnaces, and unless this coating is removed by grinding, the gold is lost in the tailing. It is not necessary that the mill stones should be burrs, ordinary granite, or basalt, will answer as well, and the cost of cutting them out and hauling them is all that is required, rendering this mode of grinding cheaper than any other that is known.

After the ore is ground, it can be amalgamated in iron pans, or wooden barrels. In the pans less time and power are required, and when well executed, probably more silver can be saved, but it will not be as fine as that extracted by the barrels.

When a barrel is worn out a carpenter can make another of wood, but when an iron pan is used up, a furnace and machine shop are required to make a new one.

It is an open question, whether pans or barrels are preferable for ore that has been ground subsequent to its roasting. The circumstance of each particular case will determine which should be used; but when the ore requires grinding, as well as amalgamating, pans are preferable.

With favorable circumstances, and economical management, ores can be reduced by this method for fifteen dollars per ton, and the loss in working will be less than by any method of reducing at present practised in this country.

This is no new and untried process, invented by some one who never saw a mine or mill, but one that has been tried by the most skilful metallurgists in the large way for years; and there is no doubt that when its merits are fully known, it will be used to the exclusion of any process at present practiced in Nevada.

MINES IN REESE RIVER DISTRICT.

Many of the mines in this district have been opened to considerable depths, as the Great Eastern, Savage, North Star, Diana and others, and the veins are larger and richer in the lowest workings than above or nearer the surface. And there is not known a single instance where the vein has grown poorer after it has been followed any considerable distance below the water level.

This proves that the veins near Austin are true fissure veins, and that their richness will be deep and continuous. So well assured are the miners of this fact, that nearly all the mines that are opening at the present time are opened by vertical shafts, which is probably the best plan where many veins are in close proximity, as in Lander Hill.

In the last year the custom price of working ore has been reduced from sixty, to forty-five dollars per ton, guaranteeing the owners of the ore eighty per cent, of a fire assay. This, in a measure, has been the cause of the steady increase in the

monthly shipments of bullion from this district, while the yield and general appearance of the mines are of the most encouraging character.

The mines of the Reese River District, have been too often described to need further description in this place, but I shall describe some of the new or what are called

OUTSIDE DISTRICTS.

These are principally located in the southeastern portion of the State, and the greater number have been recently discovered. Notice will also be taken of the operations of several companies who own property in them.

Prospecting in the southeastern portion of the State of Nevada, was greatly delayed by the hostility of the Indians. This continued until last Spring, when at a grand council of nearly all the Indians in the country, it was resolved to discontinue their opposition to the advance of prospectors, and to aid them by all the means in their power. They first discovered silver ore in the Philadelphia, Hot Creek, Northumberland, and Reveille districts, and for a small consideration sold them to white prospectors. Since then the managing agents of a number of companies operating near Austin, have secured mines in these new districts, where the ore is found in large quantities at the surface, and is much more immediately available than in mines that require opening.

Dr. W. Geller, agent for the Combination Company, was the first who secured property of this kind for his company, and the result has proved the wisdom of his calculations. Afterwards, other agents pursued the same course for their companies, and at present a number of different companies are operating in these outside districts.

THE PHILADELPHIA DISTRICT.

This district was discovered about a year ago, by an Indian, who showed it to some white men, who located all the veins that they thought to be valuable.

This property then located, was subsequently purchased by Dr. Geller for the Combination Company, with the wood and water located by the discoverers of the district. This district is about seventy-five miles southeasterly from Austin, to which it is connected by a good road.

Wood is abundant and of easy access, and water also, for present purposes, from two large springs; but when the mines are opened, it will no doubt, be found in them in sufficient amounts for all the purposes for which it may be required.

Salt is abundant at the Smoky Valley Salt Marsh, which is about thirty-five miles from the district.

The county rock is composed of granite, slate, and limestone; while volcanic rocks are abundant in the immediate vicinity. Few veins are found in the granite, which so far as known, are entirely barren. The slate carries the great majority of the metalliferous veins. It forms a belt about a mile and a-half wide, and has been traced on the surface for a distance of several miles, bounded on one side by granite, and on the other by limestone, and in places covered by volcanic rock.

The limestone contains few veins, of any note, except the Silver Champion, which is remarkably rich.

The general strike of the veins is about northwest, and south east, with a dip to the northeast.

THE HIGHBRIDGE.

This vein has been more fully opened than any other in the district. It was one of the first locations, and purchased by the Combination Company, who own nearly five thousand feet of it. They have since last Spring been engaged in developing their mine, before erecting a mill, and have opened it on the surface for the distance of three hundred feet in length, to a considerable depth, and run a tunnel cutting the vein at a depth of over one hundred feet from the surface. This tunnel, which has been recently completed, develops ore of superior richness.*

The company have a forty-stamp mill on hand, which they purpose to erect at the earliest moment next Spring, and have a sufficient amount of ore in sight in this mine alone to supply the mill for a year without any further developments.

Buel & Co. have a claim on this vein adjoining that of the Combination Company. It is of much less extent, but has been worked with great vigor, and a ten-stamp mill has been reducing

*Since the above was written this Company have run in another tunnel 760 feet north from their most southern works, and at the depth of 130 feet from the surface struck ore of superior quality, thus proving the richness of this vein for nearly 1000 feet.

the ores from it for some months. This was one of the pioneer mills in the Reese River district, and is not well adapted to the reduction of the ore. Moreover, it was erected in great haste. Yet, notwithstanding all of these unfavorable circumstances, it has produced about one thousand dollars per day for each day since it has been in full operation. The mill saves only about from fifty per cent. of the silver in the ore, still the average yield has been near one hundred dollars per ton. With a properly constructed mill the yield would be greatly increased.

Adjoining this is a small claim, owned by Buel & Wood by a recent purchase. But little development has been made on it.

Next south is the ground owned by Allen & Bateman. This is a small claim, actively worked, and looks finely.

Still south of this is the claim of Canfield & Co. This is a larger claim, and has been opened but slightly.

All of these claims have ore of the same character, and so far as is known, of equal richness.

The ores at the surface contain silver in the forms of carbonate and chloride, the carbonate greatly predominating. Below the water level the ores will probably be found combined with sulphur, which will require roasting before they can be reduced by amalgamation.

The strike of this vein is nearly north and south, with a dip to the east.

Its thickness cannot be easily determined, as, where it has been opened, it is composed of several different strata, and usually only one crops to the surface.

Where the Combination Company first opened, only one stratum cropped to the surface, and the vein was supposed to be about six feet thick, but when uncovered it was found to be about twenty-five feet between the walls, and composed of a number of different strata, and it is probable that when opened in other places the same arrangement of different strata, and in many cases the same thickness will be found where now it is supposed to be much thinner. In this stratified formation it very closely resembles the Comstock lode at Virginia, which is composed of a number of different strata separated by seams of clay and horses of the country rock; and as the Comstock developed in the depths a larger vein than the surface indica-

tions warranted, the same rule may hold good in the Highbridge.

It has been traced on the surface nearly two miles, and there is no doubt of its being deep and permanent.

THE SILVER CHAMPION.

This vein is not as large, nor has it been traced on the surface for near so great a distance as the Highbridge, but the ores are the richest that have been found in the district, and, when developed, no doubt it will prove to be a mine of great value.

The Minerva, Silver Top, and Amour, are three very promising veins, in close proximity to each other. When opened they will supply a large mill by themselves. They belong to the Combination Company, who have opened the Silver Top and Minerva down to water, and found the ore improved below the water level. This gives good promise that the other veins in the district will probably do the same when opened below the water.

When opened, these mines, especially the Highbridge, will supply a great number of large sized mills with high grade ore, thus rendering it one of the most important districts in the State of Nevada.

HOT CREEK.

This district was named from a great number of hot springs, whose waters uniting, form a creek of some magnitude, which retains its heat for a long distance below.

The country rock in this district is chiefly limestone, with small amounts of slate and granite.

All of the valuable metalliferous veins are in a belt of limestone which is from three to four miles wide, and extends in a nearly north and south direction for forty or fifty miles.

About its centre is a vast vein of quartz, from three to four hundred feet thick.

These "mother veins" are met with in every limestone district yet discovered, where rich metalliferous veins are found, as Hot Creek, Reveille, Danville, and Cortez. They are entirely barren themselves, but every other vein in their immediate vicinity is almost universally rich. The valuable mines in Hot Creek are found on each side of this vein.

The metalliferous veins are large, rich, and numerous, and many of them show large amounts of valuable ore at the surface.

T. F. Gould, Agent for the Consolidated Company, was one of the first to operate in this district. The Company have a mill running on the ores from a number of the veins in this district, but principally from the Keystone, which is largely owned by this Company.

THE INDIAN JIM.

This was the first vein located in this district.

Its strike is nearly north and south, and the dip about sixty degrees to the east.

Its thickness is from thirty to sixty feet, and it has been traced for a long distance on the surface.

The dip of this vein nearly corresponds with the slope of the mountain, and as the hanging wall is much softer than the foot wall; the action of the elements has worn it away, and uncovered the vein for five or six hundred feet in length, and fifty or sixty feet in width, thus exposing a vast body of ore, which can be mined at very little expense.

THE OLD DOMINION.

This vein has a similar strike and dip to the Indian Jim, but is not as large, although the ore is richer. It is from eight to twenty feet thick and is a very valuable mine.

The Shenandoah, is very similar to the Old Dominion, of which it may be a continuation. Its ores are very rich, and the mine valuable. Neither of these veins have been opened to but a limited extent.

THE KEYSTONE.

This has been worked to a greater extent than any vein in the district. Its strike is nearly east and west, and its dip to the north. Its greatest thickness is nearly eight feet, so far as it has been opened.

It is owned by the Consolidated Company and the Providential Company, whose agent, Mr. Gager, was one of the first to operate in this district, the Consolidated owning the greater portion.

The first ores worked from this vein, from near the surface, gave as high returns as from any vein of the same size ever worked in the Reese River county.

This is a very valuable mine, and one that can be rendered immediately available.

Besides these, there are a great number of veins in this district of great promise, as the Old Joe, Gazelle, Apollo, Gray Eagle, &c.

This is a very rich mining district, and as both wood and water are abundant, it will soon be one of the best bullion producing district in this part of the country. And the large amounts of ore near the surface render its mines more speedily available than in many other districts.

THE REVELLE DISTRICT.

This district is about forty miles south-east from Hot Creek, and in its geology and mineralogy are almost a counterpart of that district; the veins appear to be of equal size and richness, and fully as abundant.

In point of mineral wealth it is probably fully equal to Hot Creek, wood and water are fairly abundant, but not so much so as in the latter locality. This district is only forty miles from Pahrnagat, and when that country is opened, by way of the Colorado River, it may be more economical to get supplies from that source than from Sacramento.

PAHRNAGAT.

The mines in this district are found in limestone, and bear a resemblance to those in Hot Creek. Besides metalliferous veins, coal, of good quality, is found in this country, and pure rock salt, pieces having been taken from this salt mine two feet thick, which were perfectly transparent.

When railroad communication is established, these mines of coal and salt will be of great value.

The ore in these districts, to wit: the Philadelphia, Hot Creek, &c., are all more easy of reduction than the ores in many other parts of the country. Especially is this the case with those found in or near the limestone.

The per centage saved by the mill, at Philadelphia, is probably greater than the same mill would save in Virginia or

Gold Hill, whose ores are remarkable for their facility of reduction. While the results achieved at Hot Creek will probably be even more satisfactory, owing to the superior quality of the mill, and efficiency of the machinery employed.

COLUMBUS DISTRICT.

This district is situated about one hundred and fifty miles, south-west from Austin, and about fifty miles east, from Aurora.

The mines are found mostly in slate, and in the character of their ore and vein formation, very closely resemble the original Reese River District, only the veins are larger. Many of them can be traced on the surface for a long distance.

Some of these veins are of enormous size, as the Mina Prieta, which is seventy feet thick, and crops to the surface for two hundred feet in height.

Scarcity of wood and water alone renders this district less productive than almost any in the State.

VOLCANO DISTRICT.

This district is about one hundred miles south-west from Austin. It contains mines of argentiferous lead ores, mostly in the form of chromate at the surface, which also contain a small amount of gold.

But the principle ores are those of copper, of which there are larger amounts at the surface than have been found at any other point in California, or Nevada. These ores also contain silver at the rate of from ten to thirty dollars per ton.

A short distance to the south, coal is found, but the vein has not been opened sufficiently to determine its value. That which is found at the surface is greatly impregnated with calcite. It is probable that if opened it would prove valuable.

A greater variety of metals, and minerals, is found in a smaller compass in this district than in any other that I have examined in Nevada.

CORTEZ DISTRICT.

This district is about sixty-five miles north from Austin. The country rock is composed of granite, slate and limestone. Nearly all of the valuable veins being in the limestone.

The principal mining company is the Cortez Consolidated. As this Company was one of the first organized in the country, and has passed through many phases of management, it will be described somewhat at length.

The discoverer of the district located about one hundred claims for the Company, and as he had a prejudice against mines in limestone, his locations were all in slate and granite.

The Company was of vast proportions, and contained a great number of stockholders, with a prodigious quantity of stock, and transactions in the stock caused it to be very greatly dispersed.

Numerous and costly superintendents, were appointed, all of them greatly distinguished for confidence in their own abilities and total want of experience in mining enterprises. One had a fancy for roads, and spent large amounts of money in an attempt to make the highest and most precipitous mountains in that vicinity accessible. True, no ore had been found on these mountains of any value, but the grades of the road for that locality were remarkably fine. Another had a mission for prospecting, and employed a swarm of prospectors, who lived at the company's works, and during the day retired to the woods to dream of quartz, gold, silver and fortunes. Among them was a young man, of an unquiet conscience, who traveled continually in the mountains, breaking rocks and making locations. He made the valuable locations that the company works at present.

Another had a taste for mills, and expended his energies and the money of the Company in building a mill.

Another, being of a legal turn of mind, had a passion for mortgages, executions and sheriff's sales; and after a time all the original stockholders found themselves cut off from the Company by the offices of the sheriff.

After all other devices had been tried, work was commenced on the mines under the management of the present superintendent, and has been prosecuted with vigor and success, the ore paying a large profit for working. With proper management, this Company could have been working at a profit three or four years ago, just as well as at present.

There are a number of valuable mines in this district, and its close proximity to the line of the Central Pacific Railroad gives it advantages over many other districts.

There are scores of other districts that it would be interesting to notice, if space permitted, as New Pass, White Pine, Pawdit, Palmetto, Silver Peak, &c. Many of these are very rich, but want of wood or water, has retarded their development; but when the country is opened by railroads, many of these neglected districts will be of the first importance.

ARGENTIFEROUS GALENA.

In nearly all silver-bearing countries this ore is one of great importance, and it is very abundant in Nevada. It differs from the galena usually found in many other mining countries; as here the most coarsely crystallized ores are the richest in silver, the reverse being usually the case in other mining regions. It is probable that the sulphuret of silver in this ore is mechanically combined with the sulphuret of lead.

The galenas of Reese River usually contain antimony, arsenic, zinc and other metals, which render their reduction more difficult than where the ore contains principally sulphuret of lead and silver.

Many attempts have been made, in different parts of the State, to reduce these ores, but so far, none of them have been profitable.

This want of success, must be due to a lack of skill on the part of the operators, either in their estimates of the richness of the ores or in their calculations of the cost of extraction, or in a failure to extract the metal.

No finer field exists at the present time than in Nevada, for the man who can successfully and profitably reduce these argentiferous galenas.

They are found in sufficient amounts, and of the requisite richness; a great majority containing forty dollars per ton and over, in silver; and in some districts, as the Eureka, it is claimed that the average yield is over one hundred dollars per ton of silver.

Surely the difficulties of smelting are not so great as to render such ore valueless.

DIVERSE MANAGEMENT.

A few instances will be given as illustrating the effects of different modes of management on the same property.

THE GREAT EASTERN.

This Company, when organized, had a large number of veins in Big Creek district, some in Reese River, besides town lots and wood ranches, and various possessions.

After expending a large amount of money to little or no purpose; by assessment sales and other purchases, it came into the hands of its present owners.

The management was changed, and after proving the mine by an incline, in which they found some of the richest ore ever taken from the mines in the district, a perpendicular shaft was sunk to the depth of about three hundred and fifty feet. At the distance of two hundred feet, the shaft cut the Great Eastern vein, besides in its course passing through a number of others, and since then this has been one of the most productive and profitable mines in the district.

With a continuation of the former management, this property would never have yielded one dollar of profit.

THE CALIFORNIA MILL.

After this mill was erected it was run for some time, and gradually run into debt, until the debt was nearly or quite equal to the value of the mill.

At this point the management was changed, and in the course of about a year the debt was paid off, and extensive and valuable improvements made on the mill, and a fair sum paid to the owners as profit.

THE KEYSTONE MILL.

This mill was built by Captain Page, and when ready to run, the projectors of the enterprise obtained another man to run it.

This superintendent exerted himself to the utmost to make his management successful, but as he had never seen a mill or mine before, he ran behind about five thousand dollars per month.

As this was not what was wanted, it was thought best to give Captain Page the management, and he made a profit from the commencement of his operations.

These instances might be multiplied to an indefinite extent,

they are sufficient to show that a mining enterprise of the greatest promise may fail through bad management.

When this country was entirely new, and almost everything had to be tried, mistakes in all cases could not be avoided; but after so much experience in this country, any very bad mistakes must be caused by culpable ignorance.

RAILROADS.

When the railroad to California is completed, so that all materials and supplies, can be much more cheaply and quickly obtained from that country than at present; the cost of working the mines in Nevada will be greatly lessened. Many mines that now will not pay to work, will then be profitable, and the profits of those now worked will be greatly increased.

The vast deposits of copper, lead, and iron, in the State will then be available, and form interests of scarcely less magnitude than those built up by mining for the precious metals.

California has one of the finest climates and most productive soils in the world, and it seems as though Providence had made her the granary for the mining country west of the Rocky Mountains. And in process of time when the valleys of Nevada are traversed by railroads, and her depositories of salt, and coal, are brought to light for the use of the mines, and when they are developed, as they will be in the future, the annual productions of Nevada alone will be over one hundred millions of dollars, a sum greater than has been taken from the most famous mines known in ancient or modern times.

GEOLOGY.

The geology of the Reese River Region is very extensive. With the imperfect explorations already made, the principal geological divisions have been either positively determined, or approximately established.

Azoic rocks as granites, syenite, and mica schist, are abundant, and near Austin is a belt of intrusive granite which is probably of the Silurian age.

At Hot Creek the Lower Silurian has been found, its limestone being several hundred feet thick. Also some fossils, which are probably of the Devonian and the Carboniferous ages.

At Volcano the Triassic and Jurassic have been positively

identified, and the Cretaceous has been pretty clearly made out, and near Silver Peak fossils are found that probably belong to the Tertiary.

MINERALOGY.

But little attention has been paid to minerals, except such as contain the precious metals.

All of the *ores* of Silver have been found, and many of those rarer combinations which are interesting only to the mineralogist, as Kustelite, Fireblend, Bismuth Silver, Sylvanite, Carbonate of Silver, Molybden Silver, &c.; no doubt that careful examination will discover many others.

Of other minerals we have Chromate of Lead, Oxide of Antimony, Molybdenum, in various forms; Tungsten, as Wolfram, Schleet and Tungstate of Manganese. Nearly or quite all of the metals are found, in this country, in some of their combinations, and future research will find them in many more.

VEINALOGY.

The vein systems of this region are wonderfully complicated, and thermal and aqueous agencies are still in action, affording superior facilities for studying this comparatively unknown science.

GOLD AND SILVER MINING.

Eighteen years have scarcely elapsed since the first gold was mined by Americans in California. Ten years later the first silver mine was discovered at Virginia, in Nevada.

Small amounts of gold had been taken from some of the Southern States, but as an important branch of national industry, these discoveries on the Pacific coast were the initial movements.

When we consider the remoteness of the fields of operation from all the centres of civilization and commerce; that they were infested by bands of hostile Indians; in a land of remarkable sterility, and the inexperience of the American people in everything connected with this department of industry, the progress made is really wonderful.

From a trifling production in 1848, by a steady and rapid annual increase, it has, in 1866, augmented to over one hundred millions of dollars. We may look in vain for a similar develop-

ment in any other branch of industry recorded in the annals of our country.

And when we consider that these results have been obtained under circumstances of peculiar difficulty, and that the mistakes and errors incidental to a new enterprise were added to the hardships and privations of pioneers in an unexplored country, our anticipations of the probable future are too grand and magnificent to gain credence in the minds of casual observers.

But when we reflect that the production of all commodities is regulated by supply and demand, and that the demand for the precious metals is, practically, absolutely unlimited, and that, owing to the vast extent of mining territory and the countless number of mines, the production is limited only by the facilities existing and the agencies employed for their extraction from their depositories under the surface of the earth. In view of these facts, it is a perfectly safe assumption that the production of bullion will continue to increase in nearly its present ratio for two or three centuries.

And in view of its effect on the fortune of the nation as well as on that of individuals, it must be considered that it will be, for many ages, one of the most vital of our national interests.

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